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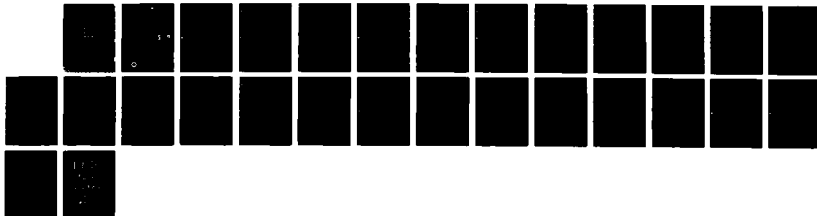
FORTRAN 77 EXTENSIONS - A COMPARISON(U) DAVID W TAYLOR
NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER BET..
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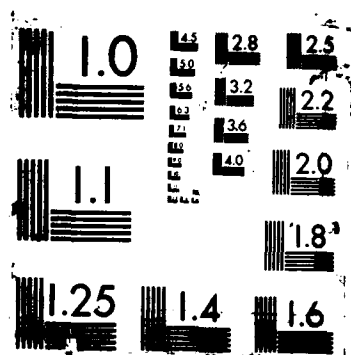
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David W. Taylor Naval Ship Research and Development Center

Bethesda, MD 20084-5000

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Computation, Mathematics & Logistics Dept.

Departmental Report

Fortran 77 Extensions - A Comparison

David V. Sommer

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This is a comparison of the extensions to the ANSI Fortran 77 Standard in the CDC NOS/BE and NOS, Cray COS, DEC VMS, and Unisys OS-1100 compilers. Appendices list the extensions keyed to specific pages or sections in the corresponding Fortran Reference Manuals. (Keywords: <i>computer language</i>)					
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Abstract

This is a comparison of the extensions to the ANSI Fortran 77 Standard in the CDC NOS/BE and NOS, Cray COS, DEC VMS, and Unisys EXEC compilers. Appendices list the extensions keyed to specific pages or sections in the corresponding Fortran Reference Manuals.

Administrative Information

The work described in this report was performed in the User Services Group (1893.1) of the Software Branch of the Computation, Mathematics and Logistics Department, David W. Taylor Naval Ship Research and Development Center, under the sponsorship of the DTNSRDC Computer Center (189).

***** Introduction *****

Programs which follow the American National Standards Institute Fortran 77 Standard should run without change (or with only changes dictated by the hardware, such as word size, integer and floating point number ranges). Programs which use extensions to the Standard will probably need modification.

This manual provides a list of the differences in the Fortran languages on the computers in the Computer Center at DTNSRDC. The Appendices list the extensions for the individual compilers.

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Page 1-2

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Feature	ANSI Standard	CDC	DEC	Unisys	Cray
symbolic name	1-6 characters	1-7	1-31	1-6	1-8
character set extensions alphabet lower same as upper N/A		N/A	lower case, \$, _ yes	lower case, \$ yes	lower case yes
special		*	*, !, <, >, %, & 72, 132	<, >, & 72	*
statement line length 72 columns		72	72, 132	72	72
comments					
column 1	C, *	C, *	C, *, ! ! in 7 on no	C, * ! in 7 on yes	C, * ! in 7 on no
end-of-line allowed after END	none no	no	D in column 1		
debugging statements					
# of continuations	19	19	19, 0-99	up to 1320 significant characters	19
special source form		sequential	tab		
compiler directives		C\$ in columns 1-2 LIST, IF, ELSE, ENDIF, COLLATE, DO		keywords ARGCHK=ON OFF, BANKED=ACTARG ALL; DUMARG RETURN, DATA= AUTO REUSE, LINE=IBUS\$, PARM INIT= INLINE, PROGRAM= BIG, STD=66, U 100=OPT EDIT controls source and object listing can DELETE lines from compilation	CDIR\$ in columns 1-5 EJECT, LIST NOLIST, CODE NOCODE, VECTOR/ NOVECTOR, NORECUR- RENCE, IVDEP, IVDMO, VFUNCTION, NEXTSCALAR, SHORT- LOOP, INT24 INT64, FASTMD SLOWMD, FLOW NOFLOW, DYNAMIC, BOUNDS, 9 optimization directives: BLOCK, NO SIDE EFFECTS, ALIGN, NOIFCON, NODOREP, RESUME- DOREP, CVL, NOCVL DEBUG NODEBUG ROLL UNROLL
statement order		NAMELIST anytime after specification statements compiler directives anywhere	NAMELIST almost anywhere DATA statements almost anywhere	COMPILER statement at start (optional) DATA statements almost anywhere EDIT lines anywhere PARAMETER anywhere before first reference DEBUG packets after all executable statements in program unit	DATA statements may be mixed in with declaratives

Feature	ANSI Standard	CDC	DEC	Unisys	Cray
Word size		60 bits	32 bits	36 bits	64 bits
Bits per character		6	8	9	8
Characters per word		10	4	4	8
Maximum program size		131071	virtual	262142 + VIRTUAL	?
Integer min		-(2**59-1)	-(2**32)	-(2**35-1)	-(2**63-1)
Integer max		2**59-1	2**31-1	2**35-1	2**63-1
Real min		10**293	.29E-38	10**-38	10**-2466
Real max		10**322	1.7E 38	10** 38	10** 2466
Signif. digs		~14	~7	~9	~14
Double min		10**293	.29D-38	10**-308	10**-2466
Double max		10**322	1.7D 38	10** 308	10** 2466
Signif. digs		~29	~16	~18	~29
constants					
INTEGER		may be octal or hex			
LOGICAL		.T., .F. allowed			
COMPLEX		may contain symbolic constants			
CHARACTER					
CHARACTER length		1 to 32767	1 to 2000	1 to 511	1 to 1317
octal		0"..."	'...'0	0...	...8
hexadecimal		Z"..."	'...'X		X"..."
Hollerith		nH...., L"....", R"....", "...."	nH...	nH...	nH...., "...."H, '....'H
Fieldata				'...'F, nH...F	
non-INTEGER dimension declarators, subscripts, substring references		converted to integer	converted to integer	converted to integer	converted to integer, also allows functions and array elements
maximum array size	not specified				4,194,304 words
single subscript for multi-subscripted array element			allowed only in EQUIVALENCE (linear element number)	yes (linear element number)	

"..." = '...''

Comparison of extensions to ANSI Standard Fortran 77

1-5

Feature	ANSI Standard	CDC	DEC	Unisys	Cray
maximum character length	not specified	32767	65535	511	16384
alternate storage of variables		LEVEL, Common Memory Manager		BANK	
two operators in succession			allowed if second is unary operator (+, -)		
conversion of double precision to complex					
character operator	//	//	//	//, & (same as //)	allowed
// with (*) in subprogram	no			yes	//
logical operator		.XOR.	.XOR.		.XOR... .N., .A., .O., .X. allowed
typeless data and expressions	not specified	BOOLEAN		36-bit strings	Boolean (octal, hex) up to 63 levels
parenthesis nesting					
equivalence character and non-character	no			yes	
run-time equivalence					POINTER
mix character and non-character in common blocks	no			yes	
named COMMON length		may be different lengths, but first loaded is actual length		may be different lengths, but first loaded is actual length	may be different lengths, but first loaded is actual length
named COMMON initial data definition	in BLOCK DATA	DATA statements anywhere		anywhere	
initialize blank COMMON	no			yes - anywhere	
special COMMON blocks					TASK

Feature	ANSI Standard	CDC	DEC	Univacs	Cray
data types		BOOLEAN	DOUBLE COMPLEX COMPLEX*8, *16 REAL*4, *8, *16 INTEGER*2, *4 LOGICAL*1, *2, *4 BYTE	DOUBLE COMPLEX typeless	DOUBLE declaration type statement type statements with *n
additional specification statements			STRUCTURE UNION MAP RECORD		
initialize in type statements	no		yes	yes	
IMPLICIT NONE	no	no	yes	no	yes
parentheses required for PARAMETER list	yes				
functions in PARAMETER statement	no	yes	yes	yes	no
DATA statements		can repeat a list of constants	may precede IMPLICIT	can define GO TO variables octal and Fieldata allowed	
DATA statement lists same length				no	
alternate DATA statement					nlist/clist logical/Hollerith correspondence
computed GO TO		expression converted to integer	expression converted to integer		
multiple assignment	no	V = V = V = e		fall thru for omitted stmt #s V, V, V = e	
assigned GO TO					statement list is ignored
arithmetic IF				falls thru missing statement labels	2-way form
logical IF					indirect

Comparison of extensions to ANSI Standard Fortran 77

1-7

Feature	ANSI Standard	CDC	DEC	Unisys	Cray
DO-loops					
extended range	no	yes	yes	yes	no
max nesting depth				25	
max loops ending on same terminator					
max variable size					15
max iteration count		2**17-1			2**23-1 (8,388,607)
additional terminators					2**23
other forms			END DO DO WHILE	FORMAT	
STOP n					
PAUSE n	1-5 digits			1-6	1-8
STOP msg		1-70 characters		1-124	1-8
PAUSE msg					(may be CHARACTER constant, variable, array element, function)
additional I/O statements		NAMELIST BUFFER IN / OUT ENCODE / DECODE PUNCH OPENMS / READMS / WRITMS / CLOSMS / STINDX	NAMELIST ACCEPT / TYPE ENCODE / DECODE REWRITE	NAMELIST DEFINE FILE ENCODE / DECODE PUNCH FIND	NAMELIST BUFFER IN / OUT ENCODE / DECODE PUNCH WRITE fmt, list OPENMS / READMS / WRITMS / CLOSMS / STINDX / FINDMS
additional file structures		random indexed	indexed keyed access		
I/O records					end-of-data
mix formatted and unformatted in file	no				yes
multi-file file	no	yes	no	no	yes (dataset)
list-directed formatting for internal files	no				
I/O unit numbers	0 or positive	0-999	0-99, converted to integer	0 or positive, character string	0-102
I/O unit number defaults		5 - SYS\$INPUT 6 - SYS\$OUTPUT		5- read 6 - write 1 - punch 0 - reread	5 - \$IN (changeable) 6 - \$OUT (chg) 100 - \$IN (perm) 101 - \$OUT (perm) 102 - \$PUNCH (perm)
default record sizes		formatted: 150 char		read - 80 or 132 print - 132 punch - 80	formatted: 152 max

Feature	ANSI Standard	CDC	DEC	Unisys	Cray
alternate REC= on READ/WRITE				'n same as REC=n	
additional parameters in OPEN INQUIRE CLOSE		yes yes no	yes yes yes	yes yes no	no no no
FORMAT in non-character array	no	yes		yes	
additional FORMAT specifications		Aw for Boolean Dw, Dw.m Rw (input: NUL fill) Zw, Zw.m "...." same as '....'	variable formats Dw, Dw.m Q Zw, Zw.m \$, NUL	Ev.dDe Dw Jw H (or READ) -wX G (for INTEGER and LOGICAL) () empty format means list-directed	A for non-CHARACTER Dw Rw (input: NUL fill) Zw \$ repeat count on / . optional where meaning unambiguous nested up to 9 levels -wX asterisk editing
input		blank LOGICAL fields are .FALSE.			
output		"I" - indefinite "R" - out of range			"R" - out of range
reread last sequential record	no			yes (use unit 0)	
implicit CLOSE at normal end of program	yes				no
PROGRAM file list	no	yes, optional			yes, optional
PROGRAM default name		START. filename\$MAIN (filename truncated to 26 characters)			
DEFINE statement function	no			yes, optional	
statement function used on left side of =	no			under some conditions	
statement function type conversion		yes			
CHARACTER statement function				may have * length	

Comparison of extensions to ANSI Standard Fortran 77

1-9

Feature	ANSI Standard	CDC	DEC	Unisys	Cray
FUNCTION name		may be same as a common block name			
FUNCTION argument list				() can be omitted if no list	
statement label in format argument list *n	*n		*n	*n, \$n	*n
calling arg list *n	*n		*n, &n	*n, \$n, &n	*n
alternate CHARACTER FUNCTION definition	CHARACTER *n FUNCTION name		CHARACTER FUNCTION name *n		DOUBLE declaration FUNCTION statement
alternate FUNCTION definition					
internal subprograms	no			yes	
alternate return		converted to integer	converted to integer		
additional intrinsics	AND, COMPL, EQV, MASK, NEQV, OR SHIFT, XOR ATANH, COSD, ERF, ERFC, SIND, TAND	AND, COMPL, EQV, MASK, NEQV, OR SHIFT, XOR ATANH, COSD, ERF, ERFC, SIND, TAND	BTEST, IAND, IBITS, IBSET, IBVCLR, IEOR, IOR, ISHFT, ISHFTC, NOT CDMPLEX, DFLOAT, IQINT, IQNINT, QEXT, QFLOAT, ZEXT ACOSD, ASIND, ATAND, ATAN2D, COSD, SIND, TAND	DCMPLEX, DCONJG, DFLOAT, DIMAG, DREAL, HFIX, IDFIX LOWERC, TRMLN, UPPERC ARCOS, DARCOS, ARSIN, DARSIN, CBRT, DCBRT, CCBRT, CCOSH, CDCOSH, CDABS, CDCOS, CDEXP, CDLOG, CDSIN, CDSORT, COTAN, DCOTAN, CTAN, CDTAN, CTANH, CDTANH, DSINH, CDSINH, ERF, ERFC, DERF, DERFC, GAMMA, DGAMMA, ALGAMA, DLGAMA	AND, COMPL, EQV, LEADZ, MASK, NEQV, OR, SHIFT, SHIFTL, SHIFTR, XOR POPCNT, POPPAR CMMSG, CVMGM, CVMGN, CVMGP, CVMGT, CVMGZ, NUMARG COT, DCOT INT24, IRTC, LINT, RTC
system subprograms	CLOCK, DATE, JDATE, SECOND, TIME RANF, RANGET, RANSET CHEKPTX, EXIT, LEGVAR, LIMERR, NUMERR, RECOVER, SYSTEM, SYSTEMC DISPLA, REMARK SSWITCH (6) MOVLCB, MOVLEV LOCF GETPARM	CLOCK, DATE, JDATE, SECOND, TIME RAN EXIT ERRSNS MVBITS %LOC	EXIT CHKRS\$, CHKSVS\$, CMLSET, DIVSET, DVCHK, OVERFL, OVFSET, OVUNFL, UNDRFL SLITE, SLITET, SSWITCH (12) LOC	CLOCK, DATE, JDATE, SECOND, TIMEF RANF, RANGET, RANSET ABORT, ERREXIT, EXIT, SYSTEM, TRBK REMARK, REMARK2, REMARKF CLEARFI, CLEARFIS, SENSEFI, SETFI, SETFIS SSWITCH (6)	

Feature	ANSI Standard	CDC	DEC	Unisys	Cray
I/O subprograms		CONNEC, DISCON, EOF, IOCHK, LENGTH, LENGTHX, UNIT		I/O executive routines	EDDW, EOF, GETPOS, IEOF, IOSTAT, LENGTH, SETPOS, UNIT
debugging		DUMP, PDUMP, STRACE post mortem dump		DUMP, PDUMP	DUMPJOB, ENDP RV, SETPRV, SYMDEBUG
collating sequence		COLSEQ, WTSET, CSOWN			
pseudo-functions				BITS, SBITS, SUBST	
argument list functions				%DESCR, %REF, %VAL	
additional statement in BLOCK DATA				EXTERNAL INTRINSIC	
name of unnamed BLOCK DATA		BLKDAT.			
internal subprograms	no			yes	
alternate return		converted to integer	converted to integer		
INCLUDE blocks of code			yes, from a file	yes, from a PDP (Procedure Definition Processor file)	
sort/merge interface		yes	yes	yes	
DEBUG facility		yes	yes	yes	yes
miscellaneous		Record Manager interface Common Memory Manager interface 8-bit subroutines data base interface 17 dummy calls to load static I/O instead of CMM overlays/capsules		because of internal subprograms, there are both local and global variables	FLOWDUMP utility FTREF utility to report about common block variable usage

Appendix A

CDC Fortran Extensions

The following are extensions to ANSI Standard Fortran 77 in the CDC FTN5 compiler:

Page in
60481300

CDC extensions to Fortran 77

1-2	. character set includes "
1-3/E	. compiler directives (C\$ in columns 1-2): LIST, IF, ELSE, ENDIF, COLLATE, DO
	. sequenced mode for source
1-4	. variable names up to 7 characters
1-6	. BOOLEAN
	. complex constants may contain symbolic constants (PARAMETER)
1-7	. Hollerith (nH..., L"...", R"...", "...") limited to 10 columns unless in CALL argument
	. octal (O"...")
	. hexadecimal (Z"...")
	. character constant 1 to 32767 characters
1-9	. array bounds converted to integer
1-10	. subscripts converted to integer
1-11	. substring references converted to integer
2-3	. can initialize common block elements in program of subprogram
	. can repeat a list of constants in DATA
2-8	. some intrinsics: AND, OR, XOR, NEQV, EQV, COMPL
2-9	. LEVEL for storage of variables
2-10	. PARAMETER may use several functions
3-6	. .XOR.
3-10	. v = v = v = e (multiple assignment)
4-1	. computed GO TO expression converted to integer
4-7	. extended DO loops
4-9,10	. PAUSE msg and STOP msg (where msg is CHARACTER constant up to 70 characters)
5-4	. FORMATS may be in non-CHARACTER array
	. Aw for boolean
	. Ow, Ow.m
	. Rw (on input: right justify, NUL fill)
	. Zw, Zw.m
	. "... in FORMAT same as '...'
5-9	. prints "I" for indefinite, "R" for out-of-range
	. blank logical input fields are .FALSE.
5-26	. PUNCH

Page in
60481300

CDC extensions to Fortran 77

- 5-30
 - . NAMELIST
 - . BUFFER IN, BUFFER OUT, UNIT, LENGTH, LENGTHA
- 5-36
 - . additional OPEN parameter
- 5-40
 - . ENCODE, DECODE
- 6-1
 - . PROGRAM may have a list of files
- 6-6
 - . function name can be same as a common block name
- 6-7
 - . alternate RETURN converted to integer
- 6-9
 - . type conversion done for statement function references
- 6-13
 - . unnamed block data subprogram has name "BLKDAT."
- 7
 - . more intrinsics: ATANH, COSD, ERF, ERFC, LOCF, MASK, RANF, SECOND, SHIFT, SIND, TAND
 - . system: GETPARM, RANSET, RANGET, DATE, JDATE, TIME, CLOCK, DISPLA, REMARK, SSWTCH, EXIT, CHEKPTX, RECOVR, MOVLEV, MOVLCH
 - . I/O: CONNEC, DISCON, EOF, IOCHEC, OPENMS, WRITMS, READMS, CLOSMS, STINDX
 - . debugging: DUMP, PDUMP, STRACE, LEGVAR, SYSTEM, SYSTEMC, LIMERR, NUMERR
 - . collating: COLSEQ, WTSET, CSOWN
 - . static I/O: 17 dummy calls to load static I/O instead of CMM
- 8
 - . Record Manager interface
 - . Sort/merge interface
 - . Common Memory Manager interface
 - . 8-bit subroutines
 - . data base interface
- 9
 - . overlays
 - . capsules
 - . post mortem dump

Appendix B

DEC Fortran Extensions

The following are extensions to ANSI Standard Fortran 77 in the DEC VMS Fortran compiler:

Topic in
AA-D034D-TE

DEC extensions to Fortran 77

- 5.2
 - . DATA statements may appear almost anywhere
 - . up to 31 characters in symbolic name
 - . in-line comments ! in column 1 or 7 on
- 5.3
 - . character set includes lower case (same as upper), \$, _, ", !, <, >, %, &
- 5.4
 - . allows tab format for source
 - . source statements may optionally go to column 132
 - . D in column 1 for debugging statements
- 6.1
 - . REAL*4 for REAL
 - . REAL*8 for DOUBLE PRECISION
 - . REAL*16 for quad precision
 - . COMPLEX*8 for COMPLEX
 - . DOUBLE COMPLEX (or COMPLEX*16)
 - . BYTE
 - . LOGICAL*1, *2, *4
 - . INTEGER*4 for INTEGER; INTEGER*2
- 6.2
 - . Octal ('...'O), hexadecimal ('...'X), Hollerith (nH...)
 - . INTEGER constants can be in octal or hexadecimal
 - . CHARACTER constant in arithmetic expression considered Hollerith
 - . dimension bounds, subscripts, character positions converted to integer
 - . LOGICAL considered INTEGER in arithmetic context
 - . 2 operators can be in succession if second is unary operator (+, -)
- 6.3
 - . .XOR.
 - . INTEGER considered LOGICAL in logical expressions
- 6.13
 - . character constant 1 to 2000 characters
- 8.4
 - . variables may be initialized in type statements
- 8.6
 - . single subscript reference as linear element number allowed only in EQUIVALENCE
- 8.8
 - . IMPLICIT NONE
 - . character variable up to 65535 characters
- 8.10
 - . NAMELIST
- 8.11
 - . PARAMETER may include some functions
- 8.12
 - . default program name is filename\$MAIN (filename truncated to 26 characters)

Topic in
AA-D034D-TE

DEC extensions to Fortran 77

-
- | | |
|------|--|
| 8.13 | . RECORD statement |
| 8.15 | . STRUCTURE, UNION, MAP |
| 8.16 | . VOLATILE statement to prevent optimization |
| | |
| 9.1 | . statement labels preceded by & (or the standard *) in CALL |
| 9.3 | . DO WHILE |
| | . extended DO range |
| 9.4 | . END DO |
| 9.6 | . computed GO TO expression converted to integer |
| 9.9 | . alternate return converted to integer |
| | |
| 10.1 | . argument list built-in functions (%VAL, %REF, %DESCR) |
| | . %LOC built-in function |
| 10.2 | . CHARACTER FUNCTION name*n allowed (standard is CHARATCER*n FUNCTION name) |
| 10.3 | . generic names: QEXT, DCMPLX, SIND, COSD, TAND, ATAND, ATAN2D, ASIND, ACOSD |
| | |
| 11.2 | . ACCEPT |
| | . TYPE |
| | . indexed files |
| | . keyed access files |
| | . ENCODE, DECODE |
| | . REWRITE |
| | . I/O unit number converted to integer |
| | . list-directed internal READ/WRITE |
| | |
| 12.2 | . variable formats |
| | . Ow.m |
| | . Zw.m |
| | . Q |
| | . \$, NUL |
| | . ", " can be used in input to override a format |
| 13 | . additional parameters in OPEN, CLOSE, INQUIRE |
| | . DELETE a record (non-sequential file) |
| | . UNLOCK a record (non-sequential file) |
| | |
| D | . more generic functions: IQINT, IQNINT, ZEXT, DFLOAT, QFLOAT, IAND, IOR, IEOR, NOT, ISHFT, IBITS, IBSET, BTEST, IBCLR, ISHFTC |
| | . system: DATE, IDATE, ERRSNS, EXIT, SECNDS, TIME, RAN, MVBITS |

Appendix C

Unisys Fortran Extensions

The following are extensions to ANSI Standard Fortran 77 in the Unisys Fortran compiler:

Topic in
UP-8244.3

Unisys extensions to Fortran 77

- 2.1 . lower case, <, >, & are part of character set
- 2.2.1 . double precision complex
 - . octal (Oooooooooooooo - up to 12 octal digits)
 - . Filedata (' 'F or nH...F)
 - . Hollerith (nH...)
 - . CHARACTER constants up to 511 characters
- 2.2.2 . variable names may have lower case, \$ (lower case same as upper case)
 - . subscripts may be REAL or DOUBLE PRECISION (converted to INTEGER)
- 2.2.3 . allows & for //
 - . allows // of (*) strings in subprograms
 - . typeless expressions (36-bit strings) - AND, OR, XOR, BOOL, COMPL)
- 2.2.5 . comments may appear after END
- 2.2.6 . statements may be up to 1320 significant characters (may be more than 20 lines)
- 2.2.7 . in-line comments start with @ (cols 7-72 only)
- 3.2 . v, v, v = e (multiple equates)
- 4.2.2 . statement numbers in computer GO TO may be omitted (falls thru)
- 4.2.3 . assigned GO TO variable may be initialized in specification statement
- 4.3.1 . statement labels in arithmetic IF's are optional (falls thru)
- 4.5 . DO statement may end on a FORMAT
- 4.5.2 . maximum DO-loop nesting depth is 25
- 4.5.5 . DO-loop may have external range
- 4.7/8 . PAUSE n and STOP n n up to 6 digits (standard: up to 5)
- 4.7/8 . PAUSE msg and STOP msg msg up to 124 characters
- 4.9 . END ends a group of program units which may include internal subprograms

Topic in
UP-8244.3

Unisys extensions to Fortran 77

- 5.1
 - . I/O: PUNCH, DEFINE FILE, FIND, ENCODE, DECODE, NAMELIST
 - . ENCODE/DECODE like CDC with additional, optional parameters
 - . default record lengths: read - 80 or 132
 - print - 132
 - punch - 80
- 5.2
 - . default unit assignments: 5 - read
 - 6 - print
 - 1 - punch
 - 0 - reread
 - . 'n same as REC=n
 - . formats may be in non-character arrays
 - . empty format () means list-directed
- 5.3.1
 - . Jw - like Iw, except rest of field zero-filled
 - . Ew.dDe - double precision exponent
 - . Ow - octal
 - . Rw - like Aw but right adjusted (NUL filled on read)
 - . H - allowed on read
 - . -wX - allowed to backspace in line
 - . G - allowed for INTEGER and LOGICAL
 - . NAMELIST - '\$name ' or '&name ' in column 2 thru '\$END' or '&END'
 - . can reread last sequential record read
 - . new parameters on OPEN and INQUIRE
- 6.1
 - . initialization may occur in specification statements
 - . DATA statements may precede IMPLICIT
 - . CHARACTER statement function may have * length
 - . can EQUIVALENCE CHARACTER and non-CHARACTER data
 - . single subscript reference to multi-dimensioned array is linear position
 - . can mix CHARACTER and non-CHARACTER in common blocks
 - . labelled common blocks of same name don't have to be same size
 - . can initialize labelled common blocks anywhere
 - . can initialize blank common and do it anywhere
- 6.6
 - . BANK to specify where variables are to be stored
- 6.7
 - . VIRTUAL statement for specifying virtual objects
- 6.8
 - . parentheses around PARAMETER list optional
 - . PARAMETER may appear anywhere
 - . in-line or library functions allowed in PARAMETER

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- 6.9
 - . DATA statement list and values don't have to match in number
 - . statement labels (&n or \$n) allowed in DATA
 - . octal and Fielddata allowed in DATA
 - . DATA may appear (almost) anywhere
- 7
 - . may have internal subprograms
 - . statement label in calling argument list is &n, \$n as well as *n
 - . statement label in formal argument list may be \$ as well as *
 - . "EXTERNAL name (ACOB)" or (PL1) to indicate the external routine is in COBOL or PL/I
 - . if an intrinsic has more than one argument, they should all be the same type
 - . intrinsics: HFIX, IDFIX, DFLOAT, DREAL, DIMAG, DCONJG, DCMLPX, UPPERC, LOWERC, TRMLN; CDLOG, CDEXP, CDSQRT, ARSIN, DARSIN, ARCOS, DARCOS, CDSIN, CDCOS, CTAN, CDTAN, COTAN, DCOTAN, DSINH, CDSINH, CBRT, DCBRT, CCBRT, CDCBRT, CCOSH, CDCOSH, CTANH, CDTANH, CDABS, ERF, DERF, ERFC, DERFC, GAMMA, DGAMMA, ALGAMA, DLGAMA
- 7.3.2
 - . Pseudo-functions: BITS (extract bits), SBITS (BITS with sign extension), SUBSTR (extract substring of character string)
- 7.3.3
 - . System service routines: DUMP, PDUMP, DVCHK, OVERFL, UNDRFL, OVUNFL, UNDSET, OVSET, DIVSET, CMLSET, CHKSVS, CHKRSS, EXIT, LOC, I/O Executive Routine functions, SSWTCH (12 switches), SLITE, SLITET
- 7.4
 - . DEFINE a statement function (optional word)
 - . under some conditions, a statement function can appear on left side of =
 - . () not required in FUNCTION statement if no list
- 7.8
 - . EXTERNAL/INTRINSIC allowed in BLOCK DATA
- 7.11
 - . because of internal subprogram, there are local and global variables

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- 8.2 . can INCLUDE blocks of code from a PDP (Procedure Definition Processor) file
- 8.3 . can DELETE lines from a compilation
- 8.4 . EDIT controls source and object listing
- 8.5 . COMPILER directives
 - ARGCHK=ON|OFF
 - BANKED=ACTARG|ALL|DUMARG|RETURN
 - DATA=AUTO|REUSE
 - LINE=IBJS
 - PARMINIT=INLINE
 - PROGRAM=BIG
 - STD=66
 - U1110=OPT
- 9 . DEBUG facility
- L . sort/merge interface
- M . Virtual Fortran

Appendix D

Cray Fortran Extensions

The following are extensions to ANSI Standard Fortran 77 in the Cray Fortran compiler:

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Cray extensions to Fortran 77

- 1-1-4 . character set includes lower case and quotation mark (")
- 1-1-9 . variable names up to 8 characters
- 1-1-10 . inline comments start with ! (columns 7-72 only)
- 1-1-10 . compiler directives have CDIR\$ in columns 1-5

- 1-2-1 . Boolean data and operations
- 1-2-7 . .T. and .F. allowed
- 1-2-8 . octal data oooooooooooooooooooooB (1-22 octal digits)
- 1-2-9 . hex data X"xxxxxxxxxxxxxxxx" (1-16 hex digits)
- 1-2-9 . "... " and '...' are the same
- 1-2-11 . CHARACTER constant 1 to 1317 characters
- 1-2-11 . dimension declarators may be functions, array elements or non-integer variables (standard allows only integers)
- 1-2-12 . maximum array size is 4,194,304 words

- 1-3-9 . allows double to complex conversion
- 1-3-14 . logical operator .XOR.
- 1-3-20 . abbreviations .N., .A., .O., .X.
- 1-3-20 . up to 63 levels of nested parentheses in an expression

- 1-4-15 . TASK common blocks

- 2-2-3 . POINTER allows run-time equivalencing
- 2-2-8 . character length up to 16,384 characters
- 2-2-10 . IMPLICIT NONE
- 2-2-14 . labelled common blocks of same name may have different lengths but first occurrence defines the actual length

- 2-4-3 . optional statement list of an assigned GO TO is not used
- 2-4-10 . DO-loop variable may not exceed 2**23-1 (8,388,607)
- 2-4-10 . no more than 15 DO-loops may terminate on the same terminal statement
- 2-4-12 . maximum DO-loop iteration count is 2**23
- 2-4-15 . STOP n and PAUSE n n up to 8 digits
- 2-4-15 . STOP msg and PAUSE msg msg up to 8 characters;
msg is CHARACTER constant,
variable, array element
or function

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Cray extensions to Fortran 77

- 2-5-1 . end-of-data records
- 2-5-6 . can mix formatted and unformatted records in a file
- 2-5-6 . datasets (multi-file files)
- 2-5-6 . Fortran unit numbers are 0-102
- 2-5-6 . default unit numbers:
 - \$IN 5 (changeable) and 100 (permanent)
 - \$OUT 6 (changeable) and 101 (permanent)
 - \$PUNCH 102 (permanent)
- 2-5-8 . "WRITE fmt, list"
- 2-5-14 . maximum formatted record is 152 characters
- 2-5-21 . no automatic close of files at end-of-program
- 2-5-23 . NAMELIST with user control of input and output formats
- 2-5-29 . BUFFER IN, BUFFER OUT, UNIT, LENGTH
- 2-6-1 . formats may be nested to 9 levels
- 2-6-2 . commas in formats optional where meaning is unambiguous
- 2-6-10 . can specify a repeat count on "/"
- 2-6-10.1 . \$ to leave output line at end of terminal
- 2-6-15 . out-of-range number printed as "R"
- 2-6-19 . Ow format
- 2-6-20 . Zw format
- 2-6-22 . A can be used with non-CHARACTER data
- 2-6-23 . Rw format (right justified) (NUL-filled on input)
- 2-7-1 . optional file list on PROGRAM statement
- 3-1-21 . compiler directives
 - EJECT
 - LIST / NOLIST
 - CODE / NOCODE
 - VECTOR / NOVECTOR
 - NORECURRENCE
 - IVDEP
 - IVDMO
 - VFUNCTION
 - NEXTSCALAR
 - SHORTLOOP
 - INT24 / INT64
 - FASTMD / SLOWMD
 - FLOW / NOFLOW and FLOWDUMP utility
(like CDC SPY, which is available)
 - DYNAMIC
 - BOUNDS
 - 9 optimization directives: BLOCK / NO SIDE EFFECTS /
ALIGN / NOIFCON / RESUMEIFCON
/ NODOREP / RESUMEDOREP / CVL
/ NOCVL
 - DEBUG / NODEBUG
 - ROLL / UNROLL

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Cray extensions to Fortran 77

- B . **intrinsic**s:
- RANF, RANGET, RANSET, COT, DCOT, INT24, LINT, RTC, IRTC,
 CLOCK, JDATE, DATE, AND, OR, XOR, EQV, NEQV, COMPL,
 MASK, SHIFT, SHIFTL, SHIFTR, LEADZ, POPCNT, POPPAR,
 CMMSG, CVMGP, CVMGM, CVMGZ, CVMGN, CVMGT, NUMARG
- C . **utility subprograms**
- . **time**: TIMEF, SECOND
- . **system**: SYSTEM, EXIT, ABORT, ERREXIT, TRBK, REMARK,
 REMARKF, SENSEFI, CLEARFI, SETFI, CLEARFIS,
 SETFIS, SSWITCH (6)
- . **I/O**: EODW, IOEF, EOF, UNIT, LENGTH, GETPOS, SETPOS
- . **Debugging aids**: ENDPRV, SETPRV, SYMDEBUG, DUMPJOB
- E (**outmoded features**)
- . Hollerith data (nH..., "... "H, '...'H)
- . 2-way arithmetic IF
- . indirect logical IF
- . ENCODE, DECODE
- . asterisk editing
- . [-b]X editing
- . DOUBLE declaration type statement
- . DOUBLE declaration FUNCTION statement
- . DATA statement nlist/clist logical/Hollerith
 correspondence
- . PUNCH
- . type statements with *n
- . random I/O operations
- . DATA statement mixed in with declaratives
- . EOF, IEOF, IOSTAT functions
- J . FTREF utility to report about common block variable usage.

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